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SAFE ADPE Procurement Issue:

The Value of Compatibility with Existing ODP Hardware/Software

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Note to Reader

1. For an overview of the study, it is recommended that the reader begin with Part I, "Purpose and Scope", followed by Part V, "Summary and Conclusions."
2. It would be useful for readers to review Part VII, "Notes on Terminology" before addressing the remainder of the study to familiarize themselves with certain study terminology and concepts that may be both unusual and confusing.
3. Footnotes and Appendixes are either at the end of a Part, or in Part IV, at the end of each cost element. Footnotes for tables are on the table page itself.

Part I: Purpose and Scope

Compatibility with existing ODP hardware/software implies IBM compatibility. This study, however, does not address the disadvantages or advantages of IBM architecture, hardware or software, either in a technical or cost sense. Technical and cost evaluation are more appropriately performed during a formal evaluation of vendor proposals submitted in response to an RFP. This study addresses the impact of compatibility on ODP management and resources; the fact that the common architecture is IBM is not significant. This ODP internal impact is primarily due to factors such as the greater possibility for resource sharing with a common ODP architecture. Generally speaking, it is difficult to structure an RFP to include these factors. (1)

It should be emphasized at the outset that this study addresses only the compatibility of the CIA SAFE system with ODP. A counterpart study on the value of DIA compatibility is in progress. Since SAFE ADPE will be common to both CIA and DIA, until the two studies are reconciled, no final "value of compatibility" can be derived.

It is hoped that this study will serve to clarify the value of compatibility in terms of aggregate cost savings and other qualitative factors. This value must only be interpreted, however, in terms of an overall assessment that

includes procurement issues, technical, management/administrative and cost factors. For example, there may be an overriding technical reason for preferring one architecture over the others or the cost savings associated with a specific architecture may overwhelm any cost savings associated with compatibility.. The required overall assessment should, in most cases, take the form of a formal evaluation of vendor responses to an RFP.

Examples of external factors explicitly excluded from this study which are often associated with the common architecture concept but in fact are attributes of a specific architecture (e.g., IBM) are: the potential for multi-sourcing and the availability of a very large commercial software base. This study makes no effort to evaluate the truth of these assertions or their impact. Such an evaluation, if appropriate, should be done as part of an overall evaluation, since the factors described are not related to compatibility.

Finally, no effort has been made to evaluate the impact of Federal Information Processing Standards 60-63, which deal with I/O interface standards and have the practical impact of restricting most future procurements to mainframes that function with IBM-compatible peripherals. These standards, which come into effect during FY-80, may have a profound impact on the SAFE

ADPE procurement. The existence of these standards is an external factor and not associated with compatibility. It should be noted, however, that an IBM-compatible architecture will in fact meet the standard. It is not known at this time whether vendors of other mainframe architectures will have offerings that also meet the standards.

How, in a practical sense, should the results of this study and its DIA equivalent be used? First, a unified ODP-CSPO-DIA position on the "value of compatibility" must be arrived at. This value will have to be assessed as to whether it is an overriding factor or just another factor to be considered in the formal procurement evaluation. This decision as to whether it is an overriding factor is a critical one. Such a decision would be made if it were believed that the value of compatibility was so significant that the outcome of the procurement was, in effect, predetermined (at least as far as architecture). The purpose of restricting the procurement explicitly would be to avoid "exercising the marketplace." Of course, any restriction of the procurement would have to be made only after the responsible individuals convinced themselves that the case for the value of compatibility was absolutely compelling and it would be unrealistic to believe that a high score in other evaluation criteria could overwhelm the compatibility weight. The above is definitely not meant as an argument for restriction of the procurement.

In fact, in a procurement such as the SAFE ADPE, which is in the nature of a new start, a very strong case indeed would be required to restrict the procurement. It must be remembered that the government routinely is expected to absorb very heavy costs in the interests of open competition in the ADPE arena (e.g., software conversion costs, in particular assembly language code).

If a decision is made that the value of compatibility is not overriding, or that issues of procurement policy require that the procurement not restrict architectures, a method must be developed to "fold-in" the value of compatibility to the formal proposal evaluation. This will be a part of the overall SAFE ADPE procurement strategy which is currently under development.

- (1) Suggestions on how to directly integrate at least some ODP internal factors into the RFP are provided in the detailed discussion (see Part IV).

Part II. Introduction

ODP operates two major centers in the Headquarters complex: the Ruffing Center and the Special Center. Both centers are compatible in terms of hardware and system software. It is commonly believed within ODP that this compatibility between centers permits significant cost savings and provides management and operational benefits. The CIA SAFE computer center is scheduled for IOC in 1982. It is reasonable to ask what cost savings and benefits could be achieved if SAFE were required to be compatible with the existing ODP centers. The purpose of this study is to examine the issue of cost-savings and benefits associated with SAFE compatibility. Our goal would be to quantify the value of SAFE compatibility in dollar terms for use in the evaluation scheme of the SAFE hardware and system software competitive procurement. The final derived "value of compatibility" could be, for example, added to the cost of any proposed system that was non-compatible in an analogous manner to the handling of software conversion costs in proposal evaluation. It is believed that this approach is fair to both the marketplace, in that it permits an unrestricted procurement, and fair to the government, in that real-world government costs and benefits are evaluated.

In the next section, an attempt is made to arrive at a definition of compatibility that is suitable for our purposes.

The remainder of the study is devoted to a discussion of the impact of compatibility and an attempt to measure this impact in dollar terms, where possible.

Definition of Compatibility

The aspects of compatibility we are concerned with are those that enhance the possibility that ODP Ruffing Center and Special Center resources (staff and equipment) are shareable by SAFE at little or no additional cost. Examples of the support ODP resources could provide that would be facilitated by compatibility are operating system support, processing support and trained staff both on a regular and reserve (i.e., backup) basis. Another possibility for benefits is from consolidated procurement of compatible hardware and software.

Four levels of compatibility have been identified that would affect the opportunities for resource sharing. These are defined below in order of increasing compatibility. It should be noted that these four compatibility states represent a vastly oversimplified view of a compatibility situation that has a multitude of possibilities.

1. Non-Compatibility (N/C)

Non-compatibility is defined as SAFE mainframes that are not IBM-compatible (i.e., non-compatible mainframes are therefore those that do not utilize the IBM 370 series instruction repertoire). With one minor exception, ODP mainframes in the Ruffing and

2. Hardware Compatibility (H/C)

SAFE mainframes are IBM-compatible, do utilize the IBM 370 series instruction repertoire as ODP mainframes in the Ruffing and Special Centers do.

3. Hardware/Software Compatibility (H/S/C)

SAFE mainframes are IBM-compatible and SAFE operating system software is an ODP-supported IBM operating system (currently, MVS or VM).

4. Full Compatibility (F/C)

SAFE mainframes are IBM-compatible; operating system software is ODP-supported (i.e., currently MVS or VM) and the SAFE primary DBMS is an ODP-supported DBMS (currently GIM II).

In both the system software and DBMS areas, the requirement for ODP support is significant, since the depth of support is a measure of the available ODP resources that might be utilized by SAFE. For example, if SAFE mainframes are H/S compatible with ODP it would be generally possible to run the same DBMS on either. Some benefits would accrue from this possibility (e.g., in the backup area). However, if ODP does not support the particular DBMS, no in-place system programming or system engineering expertise would routinely be available. Thus to obtain maximum benefits from operating system and DBMS compatibility, supported systems are required.

The above compatibility definitions referred to SAFE mainframes as if they all were to have similar hardware and software configurations. This will not necessarily be the case. The proposed SAFE system architecture involves two levels of processors: the so-called maxi and midi levels. Even assuming that all hardware and software is similar and likewise all midi H/S is similar, compatibility questions become very complicated. It is possible to have maxi compatibility with ODP mainframes and midi non-compatibility; maxi and midi compatibility with ODP mainframes (though of varying types -- e.g., different O/S or DBMS); or less likely, maxi non-compatibility and midi compatibility.

In short, even in our simplified model of the compatibility situation, there are sixteen possibilities. The most likely possibilities are summarized below. (2)

<u>Maxi</u>	<u>Midi</u>
N/C	N/C
H/C	H/C
H/S/C	H/S/C
H/C	H/S/C
H/S/C	H/C

Each one of these situations presents different opportunities for resource sharing.

Footnotes to Part II

- (1) The TADS computer, an IBM 360/67, is the minor deviation from full IBM 370-series compatibility.
- (2) There are sixteen possibilities, since there are four compatibility situations each, for both the maxi and midi. Five states may be singled out as most likely under the following assumptions: 1) the SAFE maxi and midi may be required to have a homogeneous architecture to minimize the complexity of software development. 2) full compatibility for either the midi or maxi is unlikely due to GIM II's apparent non-suitability for SAFE.

Part III: Overview of the StudyThe Compatibility Issue

This study attempts to estimate the impact, in cost terms, of a non-compatible CIA SAFE system. Non-compatibility, as used herein, refers to a SAFE system that is not hardware (and therefore not software) compatible with the ODP Ruffing and Special Centers. This is equivalent to a SAFE system that is not configured with IBM or IBM plug-compatible mainframes. (It should be noted that the SAFE mainframe architecture has not been selected at this writing and it is the purpose of this study to assist in the selection by clarifying the value of compatibility.

Part I, "Purpose and Scope" expands upon this point.)

As discussed in Part II, "Introduction," the compatibility issue gets very complicated very quickly as there are numerous possibilities caused by two levels of SAFE mainframe hardware and the several possibilities in the area of operating system software. For the purposes of this impact analysis, costs will be derived that quantify the difference in impact to ODP between:

H/S Compatible SAFE: (Homogeneous SAFE Midi & Maxi H/S
(IBM or IBM Plug-Compatible Hardware
(ODP-supported Operating System
((i.e., VM or MVS)

and

Non-Compatible SAFE: (SAFE Midi & Maxi are not IBM or
IBM Plug-Compatible

In order to simplify the analysis, the assumption has been made that SAFE will fall into one of the categories above. Mixed modes have therefore been ignored (e.g., heterogeneous midi and maxi; non-ODP-supported O/S, etc.). This assumption is believed to be realistic.

The Model

In thinking about the impact of a non-compatible architecture on an organization such as ODP, we have chosen to organize our thoughts around a specific "model." From the viewpoint of this model, a non-compatible SAFE architecture implies a "barrier" within ODP. This architecture barrier impedes the transfer of resources between SAFE and other ODP centers, as well as the related problem: the transfer of workload. (Management can either transfer resources -- people, hardware, software, etc. -- to the "work," or transfer the workload to the resources -- i.e., load sharing.) Costs must be incurred in overcoming the architecture barrier or a reduced capability must be accepted. Examples are systems programming support and overflow load sharing in a non-compatible environment. The former can be overcome by providing separate system programming support in the SAFE center (i.e., for the non-IBM O/S). The latter workload transfer problem would cause a non-compatible ODP to, for example, live with a batch backlog.

(i.e., a reduced capability as compared to a compatible environment).

Table III summarizes the resource/workload categories and the detailed areas of non-compatibility impact. Part IV assesses the impact in each area with an attempt to develop a cost estimate, where feasible.

The Cost Impact

Costs are derived over the systems life and not the architecture life. The rationale behind this choice is discussed in Appendix III. Though the use of evaluated costs (often referred to as discounted or present value costs) is technically correct for combining costs distributed over time, this approach has not been followed. This decision has been made because of the time involved in developing these costs and our belief that the costs developed in this study are useful as rough measures of aggregate impact only. If the costs are to be used directly in proposal evaluation, discounted costs will be required. Costs have therefore been assumed in constant 1979 dollars. Occasionally, costs were most conveniently developed in FY-79 dollars. For all practical purposes, FY-79 dollars are assumed equal to 1979 dollars.

(1) Actually, the time involved in updating these costs, as it is assumed that after discussion, revisions to the costs estimates will inevitably be required.

TABLE III
Summary Sheet: Cost of Non-Compatibility
with Existing ODP Hardware/Software

Resource/Workload Category	Impact (Cost Element No)
A. Management Expertise	A-1: Increased Management Complexity and Program Risk
B. People	B-1: Impact on Personnel Management B-2: Increased Vendor System Training B-3: Additional Personnel Requirements
C. Hardware/Software	C-1: Limitations on Reconfiguration & Reutilization C-2: Unavailability of Emergency and Limited Disaster Hardware Backup C-3: Consolidated Procurement C-4: Software Exchange Limitations

(Continued)

TABLE III

Summary Sheet: Cost of Non-Compatibility
with Existing ODP Hardware/Software (con't)

Resource/Workload Category	Impact (Cost Element No.)
D. Workload	<p>D: Technical Barriers to Load Sharing (see following)</p> <p>D-1: Routine Production Load Sharing</p> <p>D-2: Routine Development Load Sharing</p> <p>D-3: Backup Load Sharing (see following)</p> <p>D-3(a): Overflow Load Sharing</p> <p>D-3(b): Disaster Backup</p>

Appendix III: Systems Life vs. Architecture Life

An important distinction can be made between systems life and architecture life. Systems life, as conventionally used, refers to the useful life of hardware in support of a specific service. Architecture life goes beyond system life and represents the estimated time until a total system reprocurement (i.e., hardware and software) will be performed.

Typically, at the end of system life, a hardware upgrade is performed and the replaced hardware is reutilized; software, however, is not totally redesigned. The end of architecture life, as defined herein, implies that software requires a "bottom-up" redesign due to system deficiencies, the increased cost of maintenance and/or evolving requirements. A competitive reprocurement of the complete system opens up the possibility of a change in architecture.

For the CIA SAFE project, a 7 year systems life beyond IOC is assumed. For the architecture life of SAFE, a fifteen (15) year estimate, beyond IOC, appears reasonable. In SAFE procurements, the systems life estimate will be used. This is because it is judged unrealistic to estimate most costs and benefits beyond the limited systems life. For example, major hardware upgrade costs, mainframe costs, and other support costs are exceptionally difficult to estimate in out-years. Vendors are reluctant to make proposals over extended time periods. Systems life, however, (e.g., to the first major mainframe upgrade) appears a reasonable period of time to evaluate costs and benefits and no longer have been

historically willing to bid over this limited time period.

Part IV. Value of Compatibility: Cost and Impact Breakdown

COST OF NON-COMPATIBILITY

Cost Element No: A-1

Cost Element : Increased Management Complexity and Program Risk

Cost Qualitative Factor

Evaluated Cost : -

Discussion

A non-compatible SAFE system would involve an architecture unfamiliar to the majority of ODP Management. In addition to the "new" architecture aspects, ODP would become a multi-architecture operation which by itself increases management complexity.

This added complexity in a multi-architecture environment is related to what is, in effect, a barrier inherent in architecture differences. This barrier inhibits or even prevents the transfer of resources (i.e., people and hardware/software) between SAFE and other ODP centers. The alternative to resource transfers, the transfer of workload, is generally speaking also impractical in a multi-architecture environment.

These constraints make management more difficult. Resources assigned to one architecture are generally not shared, limiting the usefulness of any resource "slack" or "cushion" available in the office. This requires better planning by management than would otherwise be required. The margin for error is

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smaller and the risks are therefore higher. These risks are diminished capability and a resulting impact on mission effectiveness.

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COST OF NON-COMPATIBILITY

Cost Element No: B-1

Cost Element : Impact on Personnel Management

Cost : Qualitative Factor

Evaluated Cost :

Discussion:

SAFE non-compatibility would present both advantages and disadvantages in the personnel management area.

o Advantages.

With a non-compatible SAFE, ODP would be supporting at least two distinct mainframe architectures. This would provide new challenges and opportunities for ODP personnel. Breadth of experience is an asset for a data processing professional.

It can also be conjectured that a multi-architecture environment expands our recruiting pool in that 1) prospective employees with experience in either the ODP- or SAFE-supported architecture could more quickly contribute and therefore more easily be cost-justified and 2) the breadth of experience available in a multi-architecture environment could be a recruiting incentive.

o Disadvantages.

In a multi-architecture environment transfer of personnel between SAFE and ODP Processing would be a more complicated problem than with a single architecture:

- a. Considerable training would be required (see Cost Element B-2)
- b. Productivity of transferred personnel would initially be lower even after training
- c. The pool of experienced people will be smaller.
- d. A reluctance of management to transfer personnel to work with a different architecture because of the drop in productivity. This constrains utilization of personnel resources.
- e. A reluctance of personnel to transfer to a position that requires familiarity with a different architecture (i.e., "fear of the unknown").

Cost Element No: B-2

Cost Element : Increased Vendor System Training

Cost : \$440K

Evaluated Cost : -

Discussion

If SAFE is non-compatible with ODP, SAFE personnel, who will primarily come from the current ODP organization, will require intensive training on SAFE hardware and operating systems (i.e., the vendor system), in addition to SAFE applications training.

Table B-2 provides an estimate of minimum SAFE Government professional/technical personnel post-IOC. The figures are a modification of current CSPO estimates. (1)

Other personnel requiring SAFE vendor systems training will be ODP backup personnel. These ODP personnel are cross-trained in SAFE hardware and software and primarily have other ODP functions but serve as SAFE backup when required. The number of ODP backup personnel is also estimated in Table B-2.

Analysis

The Cost of Non-Compatibility is the cost of training in the new vendor hardware and operating system(s), SAFE personnel and ODP backup and their replacements over the systems life. Total personnel to be trained pre-IOC is 60 (44 SAFE and 16 backup, from Table B-2). An estimated 10 percent or 6 new personnel annually will require similar training throughout

the systems life (2)

The vendor system training required is estimated as 20 days/trainee (= 160 hours/trainee). The direct cost of this training is further estimated as \$100/day. The total direct training cost is therefore \$2000/trainee.

During training, the employee is assumed compensated at the current FY-79 ODP average annual salary of \$21.37K, prorated over 160 hours of training (of 2080 available annually) and adjusted for 40% government burden.

Employee compensation during training =

$$(\$21.37K \times 1.4 \times 160/2080) = \$2.3K$$

The Cost of Non-Compatibility in the area of vendor system training is the total training cost, which is: (No. of Trainees) X (Direct Training Cost + Employee Compensation during Training).

For Pre-IOC training, this cost is:

$$60 \times (\$2K + \$2.3K) = \$258K$$

For training of replacements during the systems life (7 years), the cost is:

$$7 \times 6 \times (\$2K + \$2.3K) = \$181K$$

Therefore, the estimated systems life cost for vendor systems training is $(\$258K + \$181K) = \$439K$

Footnotes to Cost Element No. B-2

(1) Reference 2 includes an estimate of CIA SAFE personnel requirements. It indicates that 36 CIA SAFE "operations" personnel will be required, but excludes some (unspecified) software and engineering support to be done jointly with DIA. An additional 8 personnel ("Enhanced SAFE Staff") have been included in Table B-2. The functions of these additional personnel, though not directly addressed in Reference 2, appear to be most suitable for performance by government personnel. The resulting staff of 44 is considered for our purpose a minimum government level.

It should not be inferred that the 44 personnel will be slotted in the SAFE Operations Group or even ODP (e.g. security personnel may be from the Office of Security). The 44 personnel, in fact, exceed the 33 ODP slots estimated for the SAFE Operations Group (See Reference 3) and the overall staffing estimate in the Consolidated SAFE Requirements Document (CSRD), Reference 1.

(2) Assumes 20 percent replacement rate of which half or 10 percent require vendor system training. It is assumed the other 10 percent has vendor systems expertise through prior training or experience.

(3) From C/P&BG/MS/ODP.

(4) 26% Standard Fringe Benefit Factors with 11% (est.)

CIA G&A, see Reference 5, pages 24 & 44-49. Rounded to 40%.

Table B-2

Estimated Minimum SAFE Government Personnel Requirements (Post-IOC)

Job Category		No. of Govt. Professional/Technical Personnel	
No.	Title	Enhanced SAFE Operations Group (1)	ODP Backup
A.	Operations	-	-
A.1	Operations	21	5
A.2	Performance Mgmt.	1	1
A.3	Facilities/Config. Mgmt.	1	2
B.	Maintenance	-	-
B.1	Hardware Mnt.	1	2
B.2	Software Mnt.	-	-
a)	Systems Mnt. (Vendor)	2	0
b)	DBMS Mnt.	1	0
c)	SAFE Mnt.	2	0
C.	Administration	-	-
C.1	Project Office Admin.	4	0
C.2	Database Admin.	3	0
C.3	Security (1)	2	1
D.	Development (1)	-	-
D.1	Systems Eng. (Planning)	1	1
D.2	Applications Dev.	2	3
E.	Training/Documentation(1)	-	-
E.1	User Training	2	0
E.2	System Training	0	0
E.3	Tech. Writing	1	1
	TOTAL	44	16

(1) Enhanced SAFE Operations Group personnel are not included in Ref 20001-6 (except possibly Systems Engineering (Planning)). Government personnel in these categories are believed reasonable extensions of SAFE personnel requirements.

COST OF NON-COMPATIBILITY

Cost Element No: B-3

Cost Element : Additional Personnel Requirements

Cost : \$4090K

Evaluated Cost : -

Discussion

In an H/S compatible environment, certain ODP Processing personnel could provide common support to both Processing and SAFE; these personnel are referred to as shareable. With a non-compatible SAFE, the common support of shareable personnel is not available and an increase in SAFE personnel requirements would result.

Shareable Personnel resources are defined as those ODP professional or technical personnel (staff or contractor) supporting on-going ODP Processing activities whose work is directly applicable to SAFE at little or no additional cost. An example would be systems programming support in an H/S compatible environment.

The architecture barrier present with a non-compatible SAFE interferes with the transfer of the work product of these Shareable Personnel. To make up for this loss, an equivalent number of personnel must be included as part of overall SAFE personnel requirements. It should be emphasized that these personnel are not the full complement of SAFE staff but are

additional to those that would otherwise be required in an H/S compatible environment. Additional Personnel for Non-Compatible SAFE are therefore defined as the estimated ODP staff or contractor personnel required to support a non-compatible SAFE minus estimated ODP personnel required to support an H/S compatible SAFE. In this analysis, the difference, i.e., the number of Additional Personnel for Non-Compatibility is assumed equal to the Shareable Personnel in an H/S compatible environment.

Analysis

Table B-3 presents an estimate of the Additional Personnel for Non-Compatibility (= Shareable Personnel in an H/S compatible environment) by job category. An estimated total of 13 additional personnel are required annually in a non-compatible environment throughout the systems life. In fact, it may be argued that these additional personnel will be required throughout the architecture life. (Architecture life, as used herein, extends beyond systems life, to the time of system total reprocurement or redesign: i.e., an estimated 15 years).⁽¹⁾ Since the goal of this analysis is to develop assessments suitable for use in proposal evaluation, the cost estimate is limited to the systems life (7 years).

In Appendix B-3, an average annual cost for the 13 additional personnel is computed as \$584K. This represents the cost of funding 13 positions at an approximate average government-contractor salary. Over the 7 year systems life, this is

\$4090K (undiscounted). Thus the estimated cost of non-compatibility in the area of personnel requirements is \$4090K (1979 dollars).

(1) See Appendix III, Part III: "Architecture Life vs. Systems Life."

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Table B-3: Estimate of Additional Personnel for Non-Compatible SAFE

Job Category		Additional Personnel for Non-Compatible SAFE	Comments
No.	Title	(=Shareable Personnel w/ H/S Compatible SAFE)	(Comments below refer to difference in personnel requirements between Non-Compatible SAFE and H/S Compatible SAFE)
A.	Operations		
A.1	Operations	2	Technical Specialists required for SPD/OD interface (Already available for current IBM O/S's)
A.2	Performance Mgmt.	1	Additional person for new architecture.
A.3	Facilities/Config. Mgmt.	1	(Large body of expertise in ED/SEB on IBM H/S) Additional Config. Mgr. for new architecture.
B.	Maintenance		
B.1	Hardware Mnt.	2	IBM-compatible vendor interfaces being managed by existing staff.
B.2	Software Mnt.		Additional staff required for new vendor interfaces associated w/ new architecture.
a)	Systems Mnt. (Vendor)	6	SPD currently performs this function for IBM O/S's; new systems programming group would be required.
b)	DBMS Mnt.	*	
c)	SAFE Mnt.	*	
C.	Administration		
C.1	Project Office Admin.	*	Additional person for new architecture. (Large body of expertise in ED/SEB on IBM hardware; consolidated planning/procurement possible in H/S Compatible environment).
C.2	Database Admin.	*	
C.3	Security	*	
D.	Development		
D.1	Systems Eng. (Planning)	1	
D.2	Applications Dev.	*	
E.	Training/Documentation		
E.1	User Training	*	
E.2	System Training	*	
E.3	Tech. Writing	*	
	TOTAL	13	

*Compatibility is not judged to have an impact on personnel requirements.

Cost of Non-Compatibility: Cost Element B-3

APPENDIX B-3

Cost of Additional PersonnelRequired to Support a Non-Compatible SAFE

TABLE 1: Computation of Average Salary of Additional Personnel

Govt. Grade	FY-79 Govt. Salary (1)	Burdened Govt. Salary (2)	Contractor Salary (3)	Avg. Salary (4)
GS-11	21.8K	30.5K	43.6K	37.1K
GS-12	26.2K	36.7K	52.4K	44.6K
GS-13	31.1K	43.5K	62.2K	52.9K

(1) Assuming Step 5

(2) 40% burden added to FY-79 Govt. Salary

(3) 100% burden added to FY-79 Govt. Salary

(4) Average of Burdened Govt. Salary and Contractor Salary

Cost of Non-Compatibility: Cost Element B-3
 Appendix B-3 (continued)

Table 2: Estimated Annual Cost of Additional Personnel

Job Category		Annual Additional Personnel	Est. Equivalent Govt. Grade	FY-1979 Avg. Salary/ Person	Annual Cost
No.	Title				
A.1	Operations	2	GS-11	37.1K	74.2K
A.2	Perf. Mgmt	1	GS-13	52.9K	52.9K
A.3	Facilities	1	GS-11	37.1K	37.1K
B.1	Hdwre. Mnt.	2	GS-11	37.1K	74.2K
B.2a	Softwre. Mnt. (Systems)	6	3 GS-13 3 GS-12	52.9K 44.6K	158.7K 133.8K
D.1	Sys. Eng.	1	GS-13	52.9K	52.9K
		13	GRAND TOTAL		\$ 584K (1)

(1) Annual cost of 14 additional personnel, in FY-79 dollars.

COST OF NON-COMPATIBILITY

Cost Element No: C-1

Cost Element : Limitations on Reconfiguration and Reutilization

Cost : \$490K

Evaluated Cost :

Discussion

If the SAFE Center were non-compatible with other ODP centers, the transfer of hardware between centers would generally be impossible. Reconfiguration between centers includes the temporary transfer of equipment for test purposes and the permanent re-allocation of equipment to satisfy higher priority requirements, improve performance and balance workload.

Reutilization occurs when the requirement in one center for a hardware item no longer exists (i.e., equipment reaches the end of its systems life). Opportunities for reutilization would then be explored within ODP (and throughout CIA) prior to release to GSA as excess to agency needs. Reutilization is really a special form of reconfiguration in which the equipment has reached the end of its systems life due to capacity limitations or technological obsolescence.

Reconfiguration and reutilization (R/R) are currently routine activities within ODP. R/R is distinguished from (1) emergency and (limited and full) disaster backup in that R/R is for long-term service improvement or configuration test.

Analysis

A rough bound on the value of reutilization with an H/S compatible SAFE may be computed under the following assumptions:

(1) SAFE Center hardware will not be reutilized (in another ODP center) until the end of systems life (by definition).

(2) Unlike the other ODP centers, the SAFE Center will support a single high performance service; equipment that has reached the end of its systems life in the Ruffing or Special Centers will, generally speaking, not be suitable for SAFE operations for performance reasons.

(3) Excluding workstations and printers, an estimate of the purchase price of the CIA SAFE IOC configuration is \$6023K (1979 dollars). (See Appendix C-1).

At the end of the systems life, it is estimated that the residual value of the SAFE hardware is 10% of the initial purchase price: i.e., 10% of \$6023K or \$602K. Furthermore, it is assumed that at the end of systems life, 50% of the SAFE equipment (by value) can be reutilized. Therefore, a rough estimate of the value of reutilization is 50% of \$602K or (1) approximately \$300K.

A similar approach may be used to bound the value of re-configuration. The following assumptions are made in this case:

(1) SAFE being a single high priority/high performance

service will not divert any hardware prior to the end of systems life for use in other ODP centers (and thereby suffer degradation in SAFE performance).

(2) At the midpoint of systems life, SAFE hardware (excluding workstations and printers) is valued at 50% of the purchase price or \$3012K. It is furthermore assumed that 25% of the SAFE equipment (by value) is swapped for higher performance Ruffing or Special Center equipment. This swapping (i.e., reconfiguration) results in a 25% increase in SAFE equipment capacity and no significant degradation in ODP service performance (as distinguished from equipment performance).

In line with the assumptions above, at the midpoint of systems life, reconfiguration provides a 25% increase in equipment value for 25% of the equipment, or: $.25 \times .25 \times \$3012K = \$188K$. Thus the value of reconfiguration may be roughly estimated as \$188K.

This admittedly is a crude approach that assumes no loss of value in the ODP centers receiving presumably lower performance equipment.

The net value of reconfiguration and reutilization is $\$188K + \$300K = \$488K$ (1979 dollars). This figure should be taken as a rough guide only.

(1) Theoretically, residual value is a government-wide (not agency-specific) concept. Therefore, SAFE hardware will have an estimated \$602K residual value independent of whether

reutilization in ODP or the Agency is possible: i.e., the value accrues to the government not to an agency. (for example, in a procurement evaluation, residual value is computed for all hardware irrespective of the real prospects for reutilization in an agency.) However, the approach followed above, though conceptually imperfect, does reflect the real-world benefit to ODP and the Agency.

(2) Another major problem with this approach is that it fails to properly account for the interaction between reconfiguration and reutilization. A more detailed analysis was judged beyond the scope of this study.

Appendix C-1(a)

Estimated Purchase Price of IBM-Compatible
CIA SAFE IOC Configuration (exc. Workstations
and Printers)

The IOC configuration assumes a User Terminal Support subsystem sized for approximately 600 workstations; the cost of these 600 workstations (and associated printers) is excluded from the estimate. Three approaches are available for making this estimate:

Approach 1: Use of the Marketplace

Proposals received in response to SAFE ADPE RFP would be examined. The lowest purchase price for a configuration that utilized IBM-compatible hardware would be selected.

Approach II: Use of the IBM GSA Schedule

The IBM GAS ADP Schedule would be used to price out the IOC configuration.

Approach III: Use of the [REDACTED] Configuration

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Purchase Price

[REDACTED] Proposal (Reference 4(b)) prices out a sample SAFE IOC configuration using [REDACTED] hardware. Table 1, Appendix C-1(b) is the basic cost data. The CIA SAFE IOC (1) configuration purchase price is computed to be: \$6023K.

Approach I uses competitively-derived prices and is actually ideal. Prior to proposal evaluation, however, it is (2) clearly not possible.

Approach II, use of the IBM GSA ADP Schedule Price List provides an effective "ceiling" on a true competitively-derived cost. This approach will not be used because of the time involved in developing an IBM-compatible configuration. If more time were available, this could be pursued.

Approach III uses the readily available [REDACTED] con- STATINTL configuration costs as an approximation of the cost for the comparable IBM-compatible configuration. For convenience, this approach will actually be used. Therefore,

The estimated cost of an IBM-compatible SAFE IOC configuration, for the purposes of this analysis is: \$6023K (1979 dollars).

- (1) Ignoring the DIA subsystem costs, the workstation and printer costs, and using only half of the User Terminal Support subsystem (i.e., UTSC--Item 7) cost.
- (2) This approach is a candidate for use in the actual RFP evaluation if the value of IBM-compatibility is actually "folded-in" to the evaluation.

Appendix C-1(b)

Estimated Purchase Price and Systems Life Cost of
CIA SAFE IOC Configuration

Table 1: Purchase Price and Monthly Maintenance of CIA
SAFE IOC Configuration. (1)

<u>SAFE ADPE Item</u>	<u>Purchase Amount</u>	<u>Monthly Maintenance</u>
1 - SCMC	\$665.2K	\$ 2,523
7 - UTSC x .5	912.6K	3,682
8 - MAPC	694.3K	2,712
9 - DCM 1	3403.5K	12,662
12 - DCM 2	347.1K	1,329
<hr/>		
TOTAL	\$6023K	\$22,908

The systems life cost of the CIA SAFE IOC configuration (excluding workstations and printers) may be approximated by assuming a seven year (84 month) systems life for the entire IOC configuration. Therefore, the (undiscounted) systems life cost is:

$$\begin{aligned} \text{Systems Life Cost} &= \text{Purchase Price} + \text{Systems Life (months)} \\ &\quad \times \text{Monthly Maintenance} \\ &= \$6023K + 84 \times 22.9K \\ &= \$7947K \text{ (1979 dollars)} \end{aligned}$$

Footnote to Appendix C-1(b)

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(1) From [REDACTED] SAFE Cost Proposal, page 5-3 (Reference 4(a)).

[REDACTED] hardware configuration; excludes DIA, workstations and printers and .5 x UTSC cost (UTSC subsystem is downsized 50% to reflect contract vice proposal workstation quantities; UTSC configuration costed will support 600 terminals.)

COST OF NON-COMPATIBILITY

Cost Element No: C-2

Cost Element : Unavailability of Emergency and Limited
Disaster Hardware Backup

Cost : \$40K

Evaluated Cost : -

Discussion

An emergency situation for our purposes is defined as an item of SAFE hardware rendered inoperative for a prolonged period of time. The problem is due to a routine malfunction and the delay is due to troubleshooting or parts supply difficulties.

A limited disaster as used herein is defined as a small number of SAFE hardware items rendered inoperative due to fire, flood, explosion, physical damage, etc. Routine equipment malfunction is excluded. The limited disaster may leave the SAFE system operative, but in a degraded mode. The equipment affected will generally require extensive refurbishment or replacement. In a limited disaster situation it is possible that hardware could be used from another ODP center. The equipment transfer could generally be performed sooner than a vendor replacement could be supplied.

A limited disaster is distinguished from a full disaster where a major portion of the SAFE Center is damaged and the SAFE system is inoperative (see Cost Element D-3(b))

The above definition also applies to the other ODP centers with SAFE hardware being used for backup. A non-compatible SAFE renders emergency and limited disaster hardware backup impossible.

Analysis

The following assumptions will be made in order to estimate the cost impact of the unavailability of emergency and disaster backup:

- (1) Because SAFE is a high priority/high performance single service, SAFE hardware will not be available for extended periods to provide backup for the ODP Ruffing and Special Centers.
- (2) With an H/S compatible SAFE, the extensive hardware in the Ruffing and Special Centers would be a candidate for SAFE emergency and limited disaster backup.
- (3) The SAFE backup is assumed required for 10% of the IOC configuration (by value) for 5% of the systems life (4 out of 84 months).

The value of the backup required may then be estimated as 5% of the systems life cost of the 10% of the system requiring backup. An estimate of the IBM-compatible CIA SAFE IOC configuration systems life cost is provided in Appendix C-1(b): i.e., \$7947K. The value of the backup provided by ODP Processing may be computed by pro-rating this systems life cost:

Value of SAFE Emergency and

Limited Disaster Backup = .05 x .1 x \$7947K

= \$40K (1979 dollars)

COST OF NON-COMPATIBILITY

Cost Element No : C-3

Cost Element : Consolidated Procurement

Cost : No Cost Impact or Impact can be Evaluated in Procurement

Evaluated Cost : -

Discussion

An H/S compatible SAFE opens up the possibility of ODP-wide consolidated procurement of hardware, software and maintenance services. Consolidated procurement may permit government cost saving through a favorable vendor pricing structure stemming from economies of scale. The larger single vendor hardware/software base possible in an H/S compatible environment increases government leverage, which may lead to improved vendor maintenance performance. Another possible benefit of a larger single vendor base (as compared with a multi-vendor base that would generally occur in non-compatible environment) is savings in the total floor space required for maintenance support and a reduction in total vendor maintenance personnel (with a savings in attendant security clearance processing costs and other government administrative support costs). Thus an H/S compatible SAFE may lead to:

- 1) ODP-wide consolidated hardware procurement encompassing larger quantities of equipment than separate procurements

as would generally be required in a multi-architecture environment.

- 2) Consolidated maintenance contracts covering larger quantities of equipment than would be the case in a multi-architecture environment. Miscellaneous resource savings (space, etc.) due to the possibilities of a large single vendor base and improved leverage over the maintenance vendor.
- 3) Consolidated software procurements covering the purchase, licensing and maintenance of multiple copies of software.

Analysis

Assessing the government cost savings in the above situations is a complex problem that is significantly related to procurement policy and practice. ODP experience indicates that vendor pricing has not been overly sensitive to volume except for some hardware procurement situations and some software licensing agreements.

Typically, vendor GSA ADP Schedules show purchase and maintenance prices on a "per box" basis and software licensing and maintenance on a "per CPU" basis. Furthermore, assumptions about savings from vendor volume discounts are probably true within a specific vendor's pricing structure; however, between vendors, actual price comparisons are required.

That being the case, loss of consolidated procurement, through non-compatibility, will have an unknown cost impact. Assuming cost benefits to be associated with consolidated procurement would be an example of "prejudging the marketplace." The SAFE procurement itself can be used to determine vendor pricing practices by requiring vendors to propose the hardware/software and maintenance services required over the systems life. No marketplace inferences need or should be made external to the initial SAFE procurement. (3)

In a non-compatible environment, volume discounts through consolidated procurements and maintenance, and benefits due to a large single vendor base would, generally speaking, not be possible. (4) The impact of the loss of these savings and benefits is assessed in more detail below:

- 1) Consolidated Hardware Procurements. Consolidated hardware procurements require H/S compatibility and common requirements. The SAFE hardware covered in the existing SAFE contract will be procured independent (5) of ODP Ruffing Center and Special Center requirements. Presuming H/S compatibility and common requirements, subsequent procurements, as yet unspecified, could be consolidated. These procurements would most likely (6) involve peripherals, primarily disks and terminals. Currently quantities are unknown on both the SAFE and ODP Processing sides.

As discussed earlier, though favorable pricing for a consolidated procurement is a reasonable assumption, it is far from a certainty. Use of anticipated cost saving from unspecified future consolidated procurement as a factor in an RFP evaluation or procurement decision would be a questionable practice. (7)

2) Consolidated Hardware Maintenance. Consolidated maintenance requires an additional constraint to H/S compatibility: identical vendors. While identical vendors are likely in the mainframe area (i.e., ODP has several CPU's from two of the major IBM-compatible vendors, [REDACTED], it is less certain in the peripheral area. ODP currently has a policy of OEM (8) maintenance. OEM's have not, as mentioned earlier, provided volume discounts, but priced on a "per box" basis. Maintenance for the initial SAFE hardware will be procured in the RFP. Maintenance prices will therefore be evaluated directly. (9) Maintenance for equipment subsequently procured might be less expensive if equipment were from an in-house vendor, but as this argument would be questionable for restricting competition in a procurement, it should not be considered as a factor in valuing the impact of non-compatibility.

In a similar vein to the above, maintenance vendor space requirements can be evaluated (i.e., costed) directly in

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the initial SAFE RFP. Procurement practice would require the space provided not be unduly limited, which would result in restricting the competition to in-house vendors. Arguments similar to the above discussion on consolidated maintenance pricing for follow-on SAFE procurement would dictate that hypothetical maintenance vendor space savings in future procurements not be considered an impact of non-compatibility. Procurement practice also requires, except in unusual circumstances, that security clearance and administrative support costs should not be allowed to restrict competition.

An H/S compatible SAFE may lead to a large single vendor base which improves government "leverage" over the vendor and may lead to improved hardware availability. Though the above is "logical" and "common sense," it is purely conjectural and should not be used as a basis for government decisions. Hardware availability requirements should be specified directly in the RFP and vendor capabilities evaluated, with penalties for non-performance.

3). Consolidated Software Procurement and Maintenance.

Most vendor software is priced on a "per CPU" basis except where tightly-coupled networks are involved (e.g., JES3). Certain types of independent vendor software, however, are discounted when multiple copies are ordered. System software initially procured for SAFE will probably be evaluated in the RFP. In an H/S compatible environment, subsequent procurements of software for SAFE and other ODP centers from

independent software vendors and from the mainframe hardware vendors might reflect discounts due to copies running on other ODP CPU's. As in the discussion of consolidated hardware and consolidated maintenance above, the benefits are largely hypothetical and will not be considered in (11) evaluating the impact of compatibility.

Footnotes for Cost Element No. C-3

- (1) Tightly-coupled networks (like JES3) often are an exception to "per CPU" licensing; the network is priced as one CUP (though possibly containing several CPU's).
- (2) That is, four units of vendor X's equipment are not necessarily cheaper than two units of vendor X's equipment plus two units of vendor Y's. It depends, obviously, on the cost of vendor Y's equipment.
- (3) The potential for saving on procurements subsequent to the initial SAFE procurement is a more complicated issue and is discussed in the following sections.
- (4) This ignores the possibility of a multi-architecture consolidated procurement; e.g., vendors with multi-architecture product lines or third party maintenance or leasing firms could respond to multi-architecture consolidated procurements.
- (5) With the possible exception of CRT terminals.
- (6) Note that consolidated terminal procurement may be possible even without H/S compatibility.
- (7) It should be noted that Computer System Division at NPIC is a Univac-compatible operation. Therefore, e.g., if SAFE were Univac-compatible, there exists the possibility of consolidated procurements between NPIC and SAFE. (ODP has already procured CRT terminals in a consolidated procurement with NPIC.)

- (8) This is currently under study within ODP Processing.
- (9) The possibility of a vendor providing a maintenance price reduction on ODP Processing hardware as well as SAFE hardware, and therefore not subject to evaluation in the SAFE RFP is judged small, primarily because it would be in the best interests of the vendor to reflect all discounts in the RFP.
- (10) We know of no study that demonstrates a correlation between the size of a vendor base in an installation and equipment availability.
- (11) For example, due the H/S compatibility and a multiple copies requirement in ODP, an independent software vendor might provide discounts from the single copy price of the software. However, another hardware equipment vendor might provide a similar package free, or the vendor might provide different versions which execute on different architectures and therefore discounts might be available for multiple copies irrespective of architecture, etc.

COST OF NON-COMPATIBILITY

Cost Element No: C-4

Cost Element : Software Exchange Limitations

Cost : \$470K

Evaluated Cost : -

Discussion

With a H/S compatible architecture, government-owned software could be exchanged between SAFE and other ODP centers. In a non-compatible environment software exchange would be either impossible or require an expensive conversion. Government-owned software suitable for exchange may be divided into two categories:

- 1) Contractor-developed SAFE software for which ODP Ruffing or Special Center requirements exist;
- 2) ODP-, user-, or contractor-developed software executing in the Ruffing or Special Center that satisfies a SAFE requirement.

An example of the former category is SAFE text search software. ODP personnel have indicated that a DDO text search requirement similar to SAFE's is under discussion. An example of software in the latter category might be GIM II for structured DBMS requirements or an econometric model developed by the Office of Economic Research.

Analysis

In the first category, it is estimated that 3.5% of SAFE contractor-developed software will be exchanged with other ODP (4) center. Introduction of this SAFE software will occur over the seven year systems life at an estimated rate of .5% annually. In a non-compatible environment, this software cannot simply be exchanged but must be either independently developed or converted. The estimated cost of independent development of the exchanged software would be:

$$\$313K = 3.5\% \text{ of } \$8950K \text{ (cost of contractor-developed software)}$$

(5)

Assuming 50% of the exchanged software (by value) requires development (i.e., \$157K) and the remaining software is suitable for conversion at 50% of the development cost (i.e., $.5 \times .5 \times \$313K = \$78K$), the effective value of exchanged software is: $\$157K + \$78K = \$235K$.

Considering the second category of software exchange: it is estimated that 3.5% of the SAFE software scheduled for contractor development will be available from ODP in a compatible (4) architecture environment. The resulting saving will occur pre-IOC. This equates to a \$235K estimated savings (see above computation). During systems life, the hard SAFE requirement for additional ODP-developed software is judged small. ODP mainframes will be accessible to SAFE users through the SAFE-ODP communications link. Therefore, stand-alone ODP software

packages (e.g., econometric models) will be available to SAFE users independent of SAFE architecture.

The total value of software exchange is the sum of the value in the two categories discussed above. The final estimate is therefore \$470K (1979 dollars).

Footnotes to Cost Element No. C-4

- (1) A distinction is made between licensed software and government-owned because the former generally incurs a separate cost when run on additional mainframes and, if available, can be procured irrespective of architecture compatibility.
- (2) GIM II is government-owned and therefore free; with an N/C architecture an alternative would be procurement of a comparable vendor DBMS package.
- (3) An N/C architecture would require a conversion.
- (4) The estimated 3.5% rate of software exchange is based on 1) low rate of ODP-or user-developed software exchanged between the ODP Ruffing and Special Center, 2) historical lack of success in fostering exchange in the federal government (e.g., poor performance of Federal Software Exchange Program).
- (5) See Appendix C-4 for the estimated cost of contractor-developed SAFE software.

Appendix C-4: Estimated Cost of Contractor-Developed
SAFE Software

The approximate cost of contractor-developed SAFE software is computed by first estimating the number of Lines of Source Code, converting to Project Man-Hours and then using an estimated Dollars per Man-Hour figure to generate the software development cost.

The stepwise procedure follows:

Step 1: Computation of the Number of Lines of Contractor-developed Source Code (i.e., higher order language (HOL) or assembly language (ALC)):

The contractor has provided an estimate of 445K
(1) deliverable, executable machine instructions (DEMI's)

We assume that the DEMI's are generated 50% (222.5K) from HOL source code and 50% (222.5K) from ALC source code. Assuming a conservative 2 DEMI's per line of HOL source, this implies 111.25K lines of HOL source (i.e., 222.5K DEMI's \div 2 lines HOL source/DEMI) and 222.5K lines of ALC source for a total of 333.75K Lines of Source Code.

Step 2: Computation of Number of Man-Hours of Total Project Effort: Using 173.3 Man-Hours/Man-Month (i.e., 2080 Hours/Year \div 12) and 150 Lines of Source Code per Man-
(2) Month of Total Project Effort, we compute the Man-Hours of Total Project Effort: 333.75K Lines Source Code X (173.3 \div 150) Man-Hours/Line of Source Code = 385.6K Man-Hours.

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Step 3: Final Computation of Estimated Cost of Contractor-developed Software:

$$\begin{aligned} \text{Estimated Cost of} \\ \text{Contractor-developed} \\ \text{Software} &= 385.6 \text{K Man-Hours} \times \$23.2/\text{Man-Hour} \\ &\quad \text{Total Project Effort} \quad (3) \\ &= \$8950 \text{K (1979 dollars)} \end{aligned}$$

Footnotes to Appendix C-4

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- (1) [REDACTED] estimate from Proposal, Vol. I, pages 1-19 (Reference 4(a)).
- (2) A lower quartile total effort productivity estimate from Walston and Felix, IBM Systems Journal, "A Method of Programming Measurement and Estimation," 1977, (Reference 5).
- (3) Derived from proprietary data:

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Total Project Labor Dollars ÷ Total Project Labor Hours
[REDACTED]
in 1979 dollars).

COST OF NON-COMPATIBILITY

Cost Element No. : D

Cost Element : Technical Barriers to Load Sharing

Cost : \$500K + Other Factors (see sub-elements)

Evaluated Cost :

Discussion

Load Sharing may be divided into several categories. Other cost elements are associated with the cost of transferring resources (people, hardware/software) between non-compatible architectures. Load Sharing is an alternate approach (i.e., transferring the workload) but it too is generally rendered impractical by non-compatibility.

Several categories of load sharing may be defined:

D-1. Routine Production Load Sharing.

This category implies SAFE production software is explicitly designed to run in the ODP Ruffing Center. Software in this category is not considered part of the SAFE workload (i.e., SAFE is not necessarily sized to process it). In fact, SAFE may not be able to process this software at all. (This would be the case with a non-compatible architecture.) This concept also encompasses the reverse situation: ODP production software designed to run in the SAFE Center.

D-2. Routine Development Load Sharing

SAFE systems and/or applications software development (post-IOC) is routinely performed on ODP mainframes. This activity

is primarily prime-shift activity associated with maintenance and enhancements.

D-3. Backup Load Sharing

Backup Load Sharing is subdivided into two major sub-categories: Overflow and Disaster.

D-3(a) Overflow Load Sharing

Overflow load sharing implies that under peak load conditions (e.g., backlog) workload (primarily batch) could be shifted between SAFE and other ODP centers.

D-3(b) Disaster Backup

Disaster backup implies the capability to transfer critical workload between ODP centers in the event of the unavailability of a major service. Unavailability of service as defined herein is considered to be long-term and due to a power outage, fire, flood, etc.

The impact of SAFE non-compatibility on the various categories of load sharing is discussed in the following cost sub-elements. The costs presented above are the aggregate costs associated with the load sharing categories (i.e., the sum of the load sharing sub-element costs that follow).

COST OF NON-COMPATIBILITY

Cost Sub-element No.: D-1

Cost Sub-element : Routine Production Load Sharing

Cost : No Impact

Evaluated Cost : -

Discussion

Batch processing support of SAFE in the Ruffing Center would be more straightforward in an H/S compatible environment.

(1) The SAFE CSRD, however, includes only one reference to offline batch processing requiring Ruffing Center support. This is in the SAFE Management Information System (MIS) area. SAFE is designed as an almost exclusively online system; e.g., database update is on an online continuous basis. Therefore, batch processing requirements and, in particular, offline batch requirements, are envisioned as small. Any benefits in the batch processing area associated with H/S compatibility would correspondingly be small.

Two additional factors minimize this cost sub-element:

1. The SAFE dual maxi processors in off-peak periods (primarily night) could no doubt provide a substantial batch processing capability within SAFE.

2. Any routine offline batch processing hard requirement could be satisfied by applications programs specifically designed to run on Ruffing Center mainframes. This approach would also permit ODP applications programmers to support SAFE without substantial special SAFE architecture training.

Because of adequate non-prime shift Ruffing Center capability, the reverse situation (i.e., routine ODP production assigned to the SAFE Center) should not be necessary.

- (1) Consolidated SAFE Requirements Document (Reference 1)

COST OF NON-COMPATIBILITY

Cost Sub-element No: D-2

Cost Sub-element : Routine Development Load Sharing

Cost : No Impact/Impact can be Evaluated in Procurement

Evaluated Cost : -

Discussion

With an H/S compatible SAFE, ODP Ruffing Center systems (e.g., VM) could be used for prime-shift SAFE development post-IOC, (primarily systems and applications maintenance and enhancements). With a non-compatible SAFE, development of higher-order language (HOL) programs for SAFE is technically feasible on ODP systems, though clearly inefficient. ⁽¹⁾

The proposed SAFE architecture has two levels of mainframes: so-called midi and maxi. At least one of the less expensive midi processors will be procured for backup and therefore could generally be used as a prime-shift development machine. If the maxi and midi are homogeneous (i.e., compatible in hardware and software), use of the backup midi should meet system-wide development requirements. If the maxi and midi are not compatible, a separate, probably scaled-down version of the maxi might be required for prime-shift development.

If a prime-shift development machine was not available (either through use of the midi in a homogeneous maxi-midi environment or through use of Ruffing Center mainframes), the

vendor could be required to propose an additional development mainframe, sized to support a government specified development load. Thus this cost sub-element could be handled directly in the procurement and not require an explicit government estimate of the cost of a development machine.

Recent CSPO analysis has indicated a significant cost saving associated with a homogeneous maxi-midi environment. Assuming homogeneity, because of the availability of the backup for development, non-compatibility is estimated in this category as having no cost impact. If homogeneity is not the case, this cost impact can be evaluated, as discussed above, directly in the SAFE ADPE procurement.

- (1) Development could be accomplished through the use of emulators, cross-compilers or the ODP language most similar to the SAFE HOL. These surrogate approaches are poor substitutes for development using a system compatible with SAFE. Under the surrogate approach, extensive "live" SAFE time would be required for further development, conversion, system integration, test. etc.

COST OF NON-COMPATIBILITY

Cost Sub-element No: D-3 (a)

Cost Sub-element : Backup Load Sharing (Overflow Load Sharing)

Cost : \$250K

Evaluated Cost : -

Discussion

Overflow load sharing would, in certain circumstances, be possible with an H/S compatible SAFE; i.e., under peak load conditions workload (primarily batch) could be shifted among (1) ODP centers.

In a practical sense, however, the requirement for overflow load sharing between SAFE and other ODP centers is judged small. SAFE is almost exclusively an online system; its unique system architecture (as distinguished from mainframe architecture) would render infeasible the off-loading of SAFE online tasks. In addition, the SAFE batch workload is very limited. SAFE processing capacity should be more than adequate (2) to handle SAFE batch workload during non-prime time.

During prime-time, there will be little excess SAFE capacity (3) for processing ODP overflow batch or online workload.

In non-prime time, the available capacity in the SAFE Center should increase. However, the same is true in the Ruffing and (4) Special Centers, and the requirement for overflow load sharing should be minimal. In addition, the Special Center can and (5) occasionally does serve as an outlet for Ruffing Center overflow.

Overflow load sharing, only possible in an H/S compatible environment, is therefore judged of small value to ODP.

An estimate of the value of overflow load sharing is 5% of the systems life cost of an IBM-compatible SAFE dual maxi processor (i.e., the Document/Catalog Management/Text Search Management/Index Search Management Subsystem). The underlying assumption is that 5% of an IBM-compatible dual maxi processor would be used to process Ruffing Center overflow (e.g., 10% of processor capacity during the non-prime shift). An estimate of \$4926K is developed in Appendix D-3(a) for the systems life cost of the dual maxi processor configuration.

Therefore, the value of compatibility for over load-sharing is estimated as 5% of \$4926K or \$246K (1979 dollars).

- (1) This discussion of the potential for load sharing intentionally ignores security issues inherent in inter-center load sharing.
- (2) The batch workload identified at this time (e.g., the SAFE Management Information System) is not time-sensitive. SAFE will be sized to handle prime-time online loads. During non-prime time excess capacity for batch processing should routinely be available.

- (3) As in the reverse situation, the routine off-loading of Ruffing Center online overflow (e.g., selective GIMS databases) would be a difficult technical task.
- (4) Utilizing this non-prime time capacity might require re-configuring ("downsizing") ODP online services; e.g., transferring VM from the IBM 3033 to the IBM 370/158.
- (5) Special Center overflow is negligible.

Appendix D-3(a): Estimate of the Cost of an IBM-compatible Dual Maxi Processor Configuration, Suitable for Backup Load Sharing

In the SAFE System, the Document/Catalog Management/Text Search Management/Index Search Management (DCM/TSM/ISM) Subsystem is planned as a dual maxi processor. If it were IBM-compatible, as are the ODP Ruffing and Special Centers, there would be the possibility of backup load sharing. In this appendix, an approximate systems life cost for an IBM-compatible dual maxi processor is developed. The value of IBM-compatibility for backup load sharing is estimated as the percentage of an IBM-compatible dual maxi processor subsystem resource used applied to the cost of the subsystem. ⁽¹⁾

Table 1 details the dual maxi processor configuration. Three approaches to estimating the cost of an IBM-compatible dual maxi processor configuration are now described:

o Approach I: Use of the Marketplace.

Proposals received in response to SAFE ADPE RFP would be examined. The dual maxi processor configuration with the lowest overall evaluated cost that utilized IBM-compatible hardware would be selected.

o Approach II: Use of the IBM GSA Schedule

The IBM GSA ADP Schedule Price List would be used to cost out the dual maxi processor configuration

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- o Approach III: Use of Univac Configuration Cost

The Univac dual maxi processor configuration is costed out in the [REDACTED] Cost Proposal (Reference 4(b)). Table 1 (attached) from the proposal summarizes the Univac configuration cost. The estimate is approximately \$3750K. The maintenance cost for the configuration is \$14K/month over the systems life (pg. 5.-3, [REDACTED] Cost Proposal, Reference 4(b)). Total cost over the systems life (7 years) is \$4926K.

Approach I uses competitively-derived costs and is actually ideal. Prior to proposal evaluation, however, it is clearly (2) not possible.

Approach II, use of the IBM GSA ADP Schedule Price List provides an effective "ceiling" on a true competitively-derived cost. This approach will not be used because of the time involved in developing a complete IBM-compatible configuration. If more time were available this could be pursued.

Approach III uses the readily available Univac configuration costs as an approximation of the cost for the comparable IBM-compatible configuration. For convenience, this approach will be followed. Therefore,

The estimated cost of an IBM-compatible dual maxi processor configuration is = \$4926K (1979 dollars).

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TABLE 1. Dual Maxi Processor Configuration and Univac Implementation Cost *

1.1.1.1.7 DCM/ADPE MAXI, DUAL PROCESSOR, 4M BYTES

BASIS: A UNIVAC 1100/82 DUAL PROCESSOR CONFIGURATION WITH BOTH PROCESSORS SHARING 4M BYTES OF MEMORY. PLUG COMPATIBLE DISK CONTROLLERS ARE FROM INTERSCIENCE CORPORATION AND DISKS ARE STORAGE TECHNOLOGY DUAL 600M BYTE UNITS.

DESCRIPTION	ARCHITECTURE REPORT QTY.	TOTAL BID QTY.	WBS SUB NO.
1. PROCESSOR COMPONENTS	1 LOT	1 LOT	-1
2. TAPE CONTROLLER	1	2(1)	-2
3. TAPE DRIVES	2	2	-2
4. CARD READER	0	1(2)	-3
5. LINE PRINTER	0	1(2)	-4
6. DISK SUBSYSTEM CONTROLLERS AND SHARED PROCESSOR I/F	4+6=10	10	-5
7. DISK SUBSYSTEM DISK DRIVES WITH DUAL ACCESS	(28+29)=56 AT 300 MB	15 AT 2x600 MB	-5

(1) REDUNDANT UNIT TO IMPROVE AVAILABILITY

(2) REQUIRED FOR DEVELOPMENT AND BY MANUFACTURER FOR SUPPORT

WBS	PART NO.	NAME	VENDOR	UNIT PRICE(3)	QUANTITY	EXTENDED PRICE
111171	3032-91	PROCESSOR	UNIVAC	1,216,268	1	1,216,268
111171	3032-00	PROCESSOR EXPANSION	UNIVAC	458,040	1	458,040
111171	3033-98	IOU EXPANSION	UNIVAC	283,119	1	283,119
111171	1923-00	IO CHANNEL EXPANSION	UNIVAC	7,906	2	15,810
111171	F1058-01	WORD CHANNEL MODULE	UNIVAC	40,586	4	162,224
111171	F2350-99	MEMORY EXPANSION	UNIVAC	150,000	1	150,000
111171	F3137-00	REMOTE CONTROL PANEL	UNIVAC	765	1	765
111171	2525-00	SUBSYSTEM AVAILABILITY UNIT	UNIVAC	58,520	1	58,520
111171	8508-06	MOTOR ALTERNATOR	UNIVAC	18,500	1	18,500
111172	5017-00	TAPE CONTROL	UNIVAC	21,420	1	21,420
111172	F0809-99	SIMULTANEOUS OPERATION	UNIVAC	15,984	1	15,984
111172	F0826-00	800 BPI	UNIVAC	4,320	2	8,640
111172	F0825-00	DUAL CHANNEL	UNIVAC	3,312	2	6,624
111172	0862-04	TAPE DRIVE	UNIVAC	18,824	2	33,648
111172	F1319-00	DUAL ACCESS	UNIVAC	1,838	2	3,672
111172	C1809-02	INTERFACE 6017	UNIVAC	N/C	2	0
111172	F0937-94	DUAL DENSITY	UNIVAC	1,838	2	3,672
111173	0718-02	CARD READER (W/CTL)	UNIVAC	11,628	1	11,628
111174	0776-02	PRINTER (W/CTL)	UNIVAC	35,010	1	35,010
111174	F2218-09	PRINTER CARTRIDGE	UNIVAC	1,000	1	1,000
111175	4600	DISK CONTROL	INTERSCI	57,880	10	578,500
111176	SPI	SHARED PROC INTERFACE	INTERSCI	3,830	10	38,300
111176	8860B2	DISK DRIVE (2X600MB)	STC	42,449	15	638,735
111176	8600	DUAL PORT	STC	941	15	14,115
				TOTAL		\$3,760,674

(3) LIST PRICE LESS 25% DISCOUNT FOR UNIVAC UNITS

STATINTL

Figure 5.3-1 Traceability DCM/TSM ADPE

* From [REDACTED] SAFE Proposal, Vol. II, "Cost," dated 16 March 1979, (SAF [REDACTED] -i002-3/79)

Footnotes to Appendix D-3(a):

- (1) See Cost Element D, "Technical Barrier to Load Sharing," for a definition of backup load sharing.
- (2) This approach is a candidate for use in the RFP evaluation if the value of IBM-compatibility is "folded-in" to the evaluation.

that both centers were rendered inoperative an H/S compatible SAFE would be the only in-house backup.

During non-prime shift an H/S compatible SAFE could process Agency batch workload in the event of a disaster. Only limited prime-shift SAFE processing capacity, however, would be available. ODP online systems such as GIM II and VM could, in theory, be brought up under an H/S compatible SAFE. If SAFE were not accessible from general-purpose ODP terminals (3) in a disaster situation, available SAFE terminals could be used for critical tasks.

The related problem is the use of the Ruffing and Special Centers for disaster backup to SAFE. Because of the uniqueness of SAFE system architecture (as distinguished from mainframe architecture), it appears technically infeasible to back up (4) SAFE online functions in the Ruffing or Special Center.

It is possible that special purpose backup software could be developed to provide a limited subset of SAFE capabilities (5) in the Ruffing Center. This would require an unknown but significant development effort. There would probably be some advantage if the centers were H/S compatible in developing special purpose software. However, it is probably true that special purpose software could be developed even with different architectures. Without the required development activity, the value of the Ruffing Center as a significant SAFE backup is judged small.

COST OF NON-COMPATIBILITY

Cost Sub-element No. : D-3 (b)

Cost Sub-element : Backup Load Sharing (Disaster Backup)

Cost : \$250K

Evaluated Cost : -

Discussion

Disaster backup would be possible in certain circumstances
(1)

with an H/S compatible SAFE. Under the assumption of a major catastrophe in the Ruffing or Special Center, batch workload could be processed by SAFE during non-prime shift. It is also possible that with an appropriate development effort, ODP on-line systems (e.g., GIM II, VM) could also be brought up on a SAFE processor during non-prime shift. In the event of a disaster, some SAFE functions could be supported in the Ruffing Center through special purpose software. This type of backup, however, would not be dependent on SAFE architecture.

Currently, it is generally believed that the Ruffing and Special Center provide at least partial disaster backup for (2) each other, since they are H/S compatible centers. The major drawbacks to successful backup would be the limited processing and communications capacity in the Special Center. The technical problem of backup for online systems would also be formidable. An H/S compatible SAFE would provide some "cushion" in a disaster situation where one or the other center was damaged or destroyed; or in the unlikely occurrence

In an H/S compatible environment, SAFE batch work could be supported in the Ruffing Center. The planned SAFE batch workload is insignificant and will consist of non-critical functions such as the SAFE Management Information System. The value of backup for SAFE batch workload is therefore considered minor.

The most practical automated backup for SAFE is the DIA
(6) SAFE system. Both systems will be architecturally identical. The practical means by which a CIA analyst could access DIA SAFE in the event of a CIA SAFE disaster remains to be studied. It is a function of the existence of link between CIA and DIA and the survival of a means of access to the link after the disaster. At a minimum, CIA analysts could be given physical access to DIA terminals during non-prime shift.

The Ruffing and Special Centers are judged of minor value for SAFE disaster backup. Disaster backup for the Ruffing and Special Center would primarily be performed in non-prime time on the SAFE dual maxi processors (i.e., the Document/Catalog Management/Test Search Management/Index Search Management Subsystem). An upper bound, therefore, on the value of disaster backup is the systems life cost of
(7) an IBM-compatible dual maxi processor configuration.

In Appendix D-3(a) an estimate of \$4926K is developed for the systems life cost of that configuration. It is further estimated that 5% of configuration resources would be required
(8) for disaster backup. The value of an IBM-compatible architecture for disaster backup is therefore bounded by 5% of

\$4926K or \$246K (1979 dollars) over the systems life.

- (1) Security issues in a disaster backup situation will not be addressed in this discussion.
- (2) A formal ODP disaster plan is in preparation in ODP/MS. (SAFE will not be included at this time.)
- (3) The accessibility of SAFE to general-purpose ODP terminals depends on whether ODP has implemented a unified bus architecture.
- (4) Because of its limited capacity, the Special Center is ignored from this point on as a SAFE backup.
- (5) A method for accessing incoming CIA mail from the Cable Dissemination System (CDS) would be required. Distribution of hardcopy is a possibility (though a primitive one). Note that use of automated access to CDS or hardcopy distribution is independent of SAFE architecture compatibility.
- (6) This is primarily true for SAFE private files. DIA incoming mail is not identical to CIA incoming mail. Alternate automated approaches probably utilizing Ruffing Center capabilities with the Cable Dissemination System (CDS) will be required to access CIA mail. A non-automated (and primitive) backup to private files such as microform backup could also be made available.
- (7) That is, an equivalent disaster backup to the SAFE dual maxi processor configuration could be provided by procuring an identical configuration and installing it in a separate "disaster" facility. Clearly, this is an extravagant solution. Such a disaster backup configuration would require an alternate primary

use to be cost-justified. The major portion of the cost of the disaster facility could therefore be charged to the primary use.

(8) Five percent configuration resources over the 84-month systems life is equivalent to 8.4 months use of 50% of capacity (e.g., non-prime shift) for disaster backup. One would hope that our current safety posture would limit ODP to, for example, one disaster in an 84-month period with 8.4 months required to reconstruct and re-equip the destroyed center.